Metal Rubber^TM Sensors for Skin Friction Measurements, Phase I

Completed Technology Project (2009 - 2010)

Project Introduction

The objective of this NASA STTR program is to develop conformal thin film sensors and sensor arrays for the direct measurement and mapping of distributed skin friction on the surfaces of flight-test vehicles and wind tunnel models at DFRC and other NASA centers. NanoSonic would use its patented Metal Rubber

TM

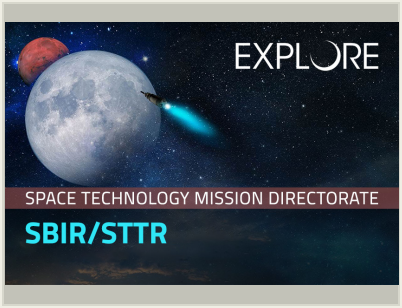
materials to fabricate the patterned "sensor skin" arrays. Metal Rubber

TM

is a free-standing self-assembled nanocomposite that acts as a transducer to convert shear stress into changes into electrical impedance. During this program, NanoSonic would work cooperatively with Virginia Tech to develop an improved mechanical and electrical model of skin friction sensor performance that will allow quantitative optimization of material properties and suggest optimal methods for sensor attachment and use for NASA applications. We will perform synthesis of sensor skin materials with optimized transduction, hysteresis and environmental properties, specifically for high Reynold's number flow and also varying temperature use. We will fabricate patterned two-dimensional sensor arrays and internal electronics using optimized materials. NanoSonic and Virginia Tech will perform complete analysis of sensor cross-sensitivities and noise sources to allow optimization of signal-to-noise ratio and practical sensor sensitivity. Support electronics will be developed to acquire, multiplex, store and process raw sensor array data. NanoSonic and Virginia Tech will also experimentally validate sensor array performance through extended water and wind tunnel evaluation, and possible flight testing, and produce a first-generation skin friction sensor array and data acquisition electronics system for sale.

Anticipated Benefits

Primary customers would be university, government laboratory and aerospace industry researchers. Small, unmanned air vehicles large enough to carry the extra load associated with electronics and power, and operationally sophisticated enough to require air data sensors would be a likely first military platform use. Distributed pressure mapping on air vehicles as well as in biomedical devices and other systems may have merit. Further, the thin film shear sensor elements may be used as air flow or water flow devices in systems where either the low weight, low surface profile, lack of need for space below the flow surface, or high sensitivity at a low cost are needed. Such broader commercial sensor opportunities would be considered during Phase II.



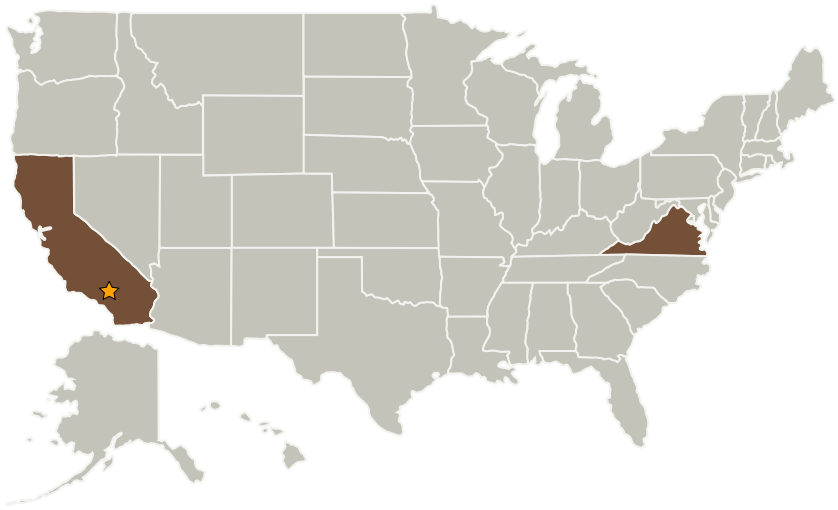
Metal Rubber^TM Sensors for Skin Friction Measurements, Phase I

Table of Contents

Metal Rubber^TM Sensors for Skin Friction Measurements, Phase I

Completed Technology Project (2009 - 2010)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Nanosonic, Inc.	Supporting Organization	Industry	Pembroke, Virginia
Virginia Tech - Aerospace and Ocean Engineering Department	Supporting Organization	Academia	Blacksburg, Virginia

Primary U.S. Work Locations	
California	Virginia

Project Transitions

January 2009: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Phil Hamory

Principal Investigator:

Hang Ruan

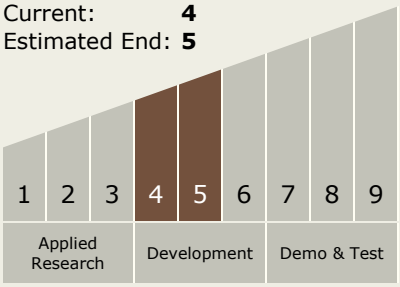
Metal Rubber^TM Sensors for Skin Friction Measurements, Phase I

Completed Technology Project (2009 - 2010)

January 2010: Closed out

Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
  - TX13.2 Test and Qualification
    - TX13.2.7 Test Instruments and Sensors